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ABSTRACT

In a sweeping effort to improve science education in Tennessee, a new curriculum framework was developed that mandated "hands-on" experiences for students, beginning in kindergarten. To smooth out problems in elementary science instruction arising from the mandate, the Center of Excellence for the Enrichment of Science and Mathematics Education at the University of Tennessee at Martin developed training programs and materials. The teacher education program model, called the Elementary Science Education Institute (ESEI), included a four-member team training structure that was central to its success. The ESEI was a response to traditional problems in science education, including the lack of supportive administrators and science specialists in rural areas. Administrators and elementary teachers took part in the two-phase program, which consisted of intensive academic preparation for nine four-member teams, and in-service field training carried out by the teams in their schools and surrounding districts. Science academicians and educators provided the initial instruction. Use of the model produced favorable changes in science content mastery, attitudes toward science, computer literacy, knowledge of the "hands-on" approach, and achievement by the teams' elementary students. Through their participation, ESEI teachers, principals, and superintendents assumed leadership roles. Also, public awareness and support for elementary science education were among the most important benefits the model produced. (TES)

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A MODEL FOR SCIENCE EDUCATION REFORM IN RURAL SCHOOLS: AN INSERVICE PROGRAM FOR LOCAL TEAM LEADERSHIP DEVELOPMENT

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A MODEL FOR SCIENCE EDUCATION REFORM IN RURAL SCHOOLS: AN INSERVICE PROGRAM FOR LOCAL TEAM LEADERSHIP DEVELOPMENT

Introduction

The need for improvement of science education is a major national issue (National Commission on Excellence in Education, 1983). There is intense pressure for reform, and existing curricula and instruction have been declared largely inadequate (Hurd, 1986). The problem was recognized as especially severe in elementary education more than a decade ago (National Science Foundation, 1978). Stake and Easley (1978) concluded that few students were likely to experience even one year of substantial science instruction from kindergarten through the sixth grade. Five years later, Mechling and Oliver (1983) noted that most of the nation's schools still lacked an adequate elementary science program. Many elementary teachers feel unqualified to teach science and devote little or no time to it (National Science Teachers Association, 1983). Without substantial reforms, most of the nation's youth will be deprived of systematic science instruction during the formative elementary years when they may benefit most from the learning processes and thinking skills promoted by science study.

A Basis for Reform

Children are naturally inquisitive, and most students enter their first formal science study with many ideas that were developed in an effort to make sense of day-to-day observations of natural phenomena in early childhood (Driver, 1983). Scientifically sound ideas of this nature constitute a basis for further science education, but research in cognitive psychology by Driver (1983), McCloskey (1983), and others indicated that many of the more common preconceptions are actually misperceptions based on perceptual illusions, intuition, naive inferences, incorrect logic, or simple misinformation. For example, when a child gives a toy truck a push and it continues to roll across the floor, the child may intuitively conclude that the toy continues to roll because a causal force was somehow imparted to the toy by the pusher. This is an intelligent, logically conceived conclusion that may be reinforced by repeated observations over the years, but it is incompatible with the principles of modern Newtonian mechanics.

When such a notion has supplied a satisfactory explanation of personal experiences over a long period of time, Clement (1982) observed, it may not be easily displaced by subsequent science instruction. Rather, when a more adequate concept is encountered in the classroom, it may be disregarded or "more likely . . . misperceived or distorted by students so as to fit their existing preconceptions" (p. 70). Some of the more common misperceptions about the relation of force and motion become so deeply entrenched among students, he noted, that they persist through college training, even among the majority of science and engineering students. This represents a major threat to science education at a time when the average citizen is increasingly dependent upon a basic understanding of science for living, learning, working, and decision-making. An effective program of science instruction beginning in kindergarten, before the common misperceptions become deeply entrenched, would help to counter that threat by providing a sound basis for later science study.

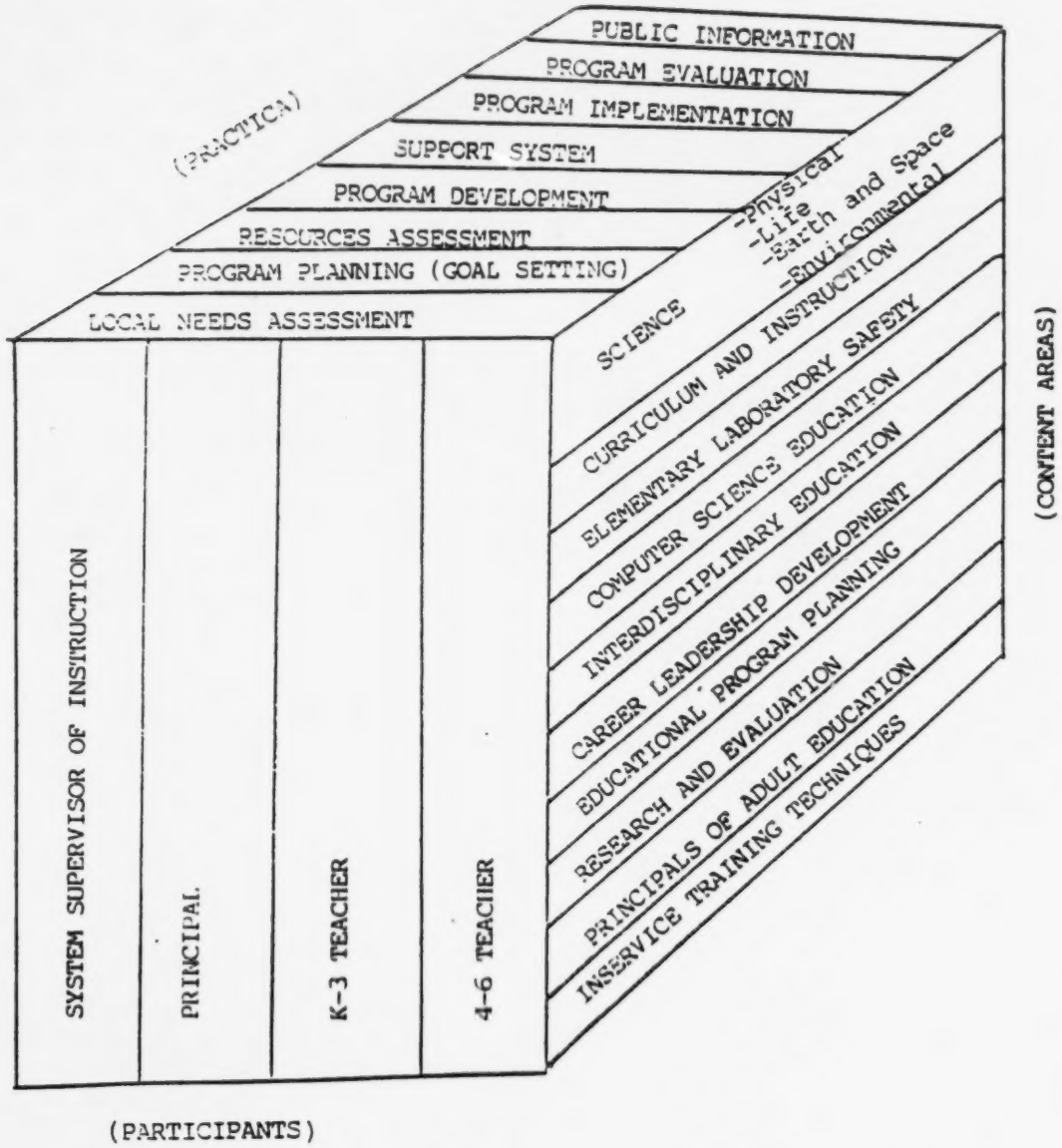
A Response to The Challenge

In a sweeping effort to improve science instruction in Tennessee, the State Board of Education developed a new science curriculum framework that mandated a "hands-on science" instructional approach for all grades from kindergarten through high school. The Board further required that sufficient time must be given to science instruction to teach the required objectives for each grade. This generated concern among school officials for several reasons. For example, no elementary science text was found that adequately addressed the objectives of Tennessee's new science curriculum (Field, 1988). In addition, few elementary teachers were comfortable with "hands-on-science" instruction, which was very different from the way they themselves had been taught science in high school and college (Prather, Hartshorn, and McCreight, 1988).

To help overcome those problems, the Center of Excellence for the Enrichment of Science and Mathematics Education (CEESME) at the University of Tennessee at Martin, developed a seven volume Science Activities Manual K-6 that was correlated to the instructional objectives of the state science curriculum guide. The manual, which was written with the cooperation of twenty-four elementary science teachers, was specifically designed for use in "hands-on-science" teaching. Still, many teachers attempted to employ it in terms of the traditional, student-passive instruction that characterized most of the science instruction they themselves had received. It soon became obvious that additional training in the use of concrete manipulatives in science instruction would be required for most inservice teachers to make the transition to that mode of teaching.

To help teachers make that transition, the CEESME developed a research-based teacher education program that included a unique combination of content instruction, field activities, and team leadership training that addressed the mandate of "hands-on-science" instruction. The resultant program model, called the Elementary Science Education Institute (ESEI), is presented in Figure 1, which shows the four-member team structure that was central to its success.

Figure 1 A Model for Reform for Elementary Science Instruction in Rural and Small School Systems through Inservice Teacher Preparation



Justification of the Concept

Over the past three decades, billions of dollars have been spent for improving pre-college science instruction, generally with very disappointing results (Yager, 1981). The problem was attributed to a variety of things, including ineffective teacher training. Some educators began to suspect, however, that something other than teacher preparation was involved.

Several studies indicated that the problem was a lack of local support for educational reform because of a basic lack of understanding of science and the resources needed for effective science instruction. For example, the support of the building principal was found to be critical to the success of any school program; but "many principals feel uncomfortable, even inadequate, with science. . . . While many principals want to improve science in their schools' curriculum, they wonder how and where to begin" (Mechling and Oliver, 1982, p. 4). In another study, Rutherford (1985) concluded that "When the principals had visions for the future of their schools, the teachers described those schools as good places for students and for teachers" (p. 32). The CEESME staff speculated that including the building principal with elementary classroom teachers in a science training program would culminate in a shared vision for enriching science in their schools.

Further research revealed that whereas large school systems generally have science specialists to provide leadership in facilitating educational reform, most rural and small school systems do not. It therefore appeared equally important that the system supervisor of instruction also participate in the program to insure an understanding of the nature and needs of science education within that dimension of the administrative structure.

Consideration of these factors resulted in a project for local team leadership development. The project was based on the presupposition that enrichment of science education in rural and small school systems would require that both the instructional and the administrative skills needed for reform be developed simultaneously. This could be accomplished within the existing educational structure through joint training of local teams of elementary teachers, principals, and supervisors of instruction.

Besides some of the obvious challenges of jointly training teachers and administrators in a new educational approach, there was the immediate concern of a shortage of elementary science teachers. A synthesis of research and evaluation in science and mathematics education by the U. S. General Accounting Office (GAO) indicated that retraining teachers from other subjects was a viable approach to overcoming the immediate teacher shortage in the fields of science and mathematics. The GAO (1984) report also indicated that "retraining programs sponsored by state education agencies (SEA's) and local education agencies (LEA's) tend to have higher retention rates than university programs" (p. iii). This was attributable in part to the fact that most SEA and LEA programs "are offered at little or no cost to participants" (p. 52). From this, the CEESME concluded that the program should concentrate on enrichment training of existing elementary

teachers who are interested in teaching science. It was also determined that the program should be offered tuition-free.

Review of the research on science education and an assessment of the needs of teachers in the UTM service area indicated that the project should consist of two parts: 1) an Elementary Science Education Institute (ESEI), providing intensive academic preparation for the participating teams; and 2) a Field Phase, to be carried out by the teams in their school systems and surrounding school districts during the following year. A support system was planned to nurture the teams' efforts throughout the year.

Approximately 240 hours of instruction was required. To accomplish this in a manner compatible with the need for prompt training of in-service elementary science teachers would require a relatively short, intensive program schedule. The GAO (1984) report, however, indicated that "in the absence of substantial scholarship and subsistence payments, short and intensive programs seem to attract few students" (p. 56). To help attract participants, a per diem of $40 was proposed, and an honorarium of $2000 and fifteen (15) quarter-hours of tuition-free graduate academic credit were also provided to those who successfully completed the academic training.

Application of the Model

The Elementary Science Education Institute was funded by the National Science Foundation (NSF) and the Tennessee Higher Education Commission (THEC), and nine four-member teams were recruited from geographically dispersed rural school systems. As indicated in Figure 1, each team consisted of a primary (grades K-3) and an intermediate (grades 4-6) teacher, their principal, and their system's supervisor of instruction or other official responsible for supervising elementary science instruction. Grant funds provided for employment of three exemplary elementary science teachers to serve as field supervisors and assist the CEESME staff in coordinating a support system for local team activities. The field supervisors received the same academic training as the team members, making a total of 39 participants. The grant provided for three project cycles for a total of 27 teams, with one cycle per year scheduled for 1987, 1988, and 1989.

The first Institute began on February 7, 1987; and the academic program extended through June. Minority participation was 18%. At the UTM campus, 240 hours of instruction were provided in the content areas indicated on Figure 1. Each team also was required to plan a one-year practicum, or field project, for the improvement of elementary science instruction based on independent, on-site research. Science academicians and educators provided instruction on science content, curriculum, and instructional methods. To introduce the "hands-on-science" teaching strategy, authors of the Science Activities Manual K-6 provided twenty-five model lessons from the manual.

A portable microteaching unit was provided for each team's use in critiquing its classroom efforts to improve instructional techniques. Participants were required to prepare and videotape lessons from the Science Activities Manual K-6. They then were

required to critique their own videotaped lessons, using criteria based on the evaluation standards of the Tennessee Career Ladder Program. The tapes were then submitted for jury review by a team of highly qualified teacher evaluators. This enabled teachers to compare their self-evaluations with those made by the jury. The teams also found the microteaching units helpful for preparing professional presentations, in-service teaching aids, and programs for local civic groups.

In keeping with the concept of team development, no distinction was made between administrators and teachers in the training process. To promote team recognition, a public information program was conducted in each team's home area to acquaint the public with their plans for improvement of elementary science education. Because of the publicity surrounding their work, the nine teams were invited to host a special conference of the Science Association of Tennessee (SAT) at UTM and present their ideas to a statewide audience. The enthusiastic response of the audience helped the teams realize their capacity for creative program development and recognize their potential for educational leadership.

By the beginning of the 1987-88 school year, each team had implemented its field project. In most cases, those projects involved conducting extensive in-service training programs in their schools. In anticipation of this, funds were provided to employ substitute teachers for a team's two teachers when they were required to be absent from the classroom on team-related activities.

Evaluation of the Model

With the conclusion of the first 18-month cycle of the project, which included the academic preparation and subsequent field activities of the nine 1987 teams, the CEESME had a sufficient data base to begin a program of statistical analyses for research and evaluation. The 1987 ESEI participants underwent evaluation in five areas: 1) science content knowledge; 2) attitudes toward science and science teaching; 3) computer literacy; 4) knowledge and utilization of the Tennessee Instructional Model, with which they are expected to work; and 5) the performance of their students.

The group showed an overall gain of approximately 10% in science content mastery, with greatest gains in earth and space science (9.8%) and physical science (9.3%). Gains of approximately 7.8% in environmental science and 4.0% in life science were also observed. This may be due to the fact that the prior science preparation of most participants was concentrated in life science, with more limited backgrounds in the physical and earth-space sciences. Data were gathered from pre-tests and post-tests using an 80-item survey, with a number of questions from each of the major science areas proportional to the number of objectives from each field in the Tennessee Science Curriculum Guide K-6. Estimates of instrument reliability, which were obtained by computing coefficient ALPHA, ranged from 0.77 to 0.82.

Pre-tests and post-tests of participants' attitudes towards science and science teaching were also surveyed using a 70-item attitude survey instrument. Favorable changes were shown in both areas, but additional research will be required to determine whether the responses of teachers and administrators differed significantly.

Attitudes toward the use of computers in the classroom were also examined. A sharp rise in the participants' confidence in their ability to use the computer was noted. With some surprise, it also was learned that the computer instruction provided by the CEESME constituted the first formal training in computers for a majority of the ESEI members. Knowledge and utilization of the Tennessee Instructional Model (TIM) were studied through examination of lessons that were presented and videotaped in the participants' classrooms. The lessons were evaluated by a jury of highly trained teacher evaluators, which allowed the teachers to see themselves as a state teacher-evaluator would see them.

Data were also collected from 44 Tennessee classrooms to compare the performance of students taught by the ESEI teachers with that of students in classes taught by other teachers in the same school (HOME) and in schools in non-participating districts (CONTROL). Comparisons were made on the basis of pre-tests and post-tests, using separate instruments for K-3 and 4-6 students. The K-3 study (n=411) involved first and second grades. The 4-6 study (n=491) involved fourth, fifth and sixth graders. After a year of instruction, the first and second grade ESEI classes showed greater gains in content knowledge than either the HOME or CONTROL group. In all comparisons for grades 4-6, except ESEI with CONTROL in the fourth grade, the ESEI group performed better than the respective HOME or CONTROL group, with significant improvements ($p < .01$) in many cases.

The development and progress of the teams' field practica provided a further basis for assessment of the effectiveness of the ESEI model. At the beginning of the Institute, each team was required to survey its school system's elementary science education needs and resources and to research options for improvement of elementary science teaching during the following school year. The teams developed programs for systematic dissemination of the content and skills they gained in the ESEI through in-service programs for their peers. The teams prepared public information programs to generate local support for reform of elementary science education beginning at the "grass-roots" level. The public relations value of preparing and submitting news items to local newspapers was quickly recognized by the group, and several teams became proficient in obtaining coverage (one team boasted 17 news items). The support system provided by the three field supervisors was a key factor to the teams' success in the early implementation of their practica.

At the beginning of the Institute, only about 26% of the participants indicated that they believed they could teach elementary science in the "hands-on" mode called for in the State Science Curriculum. At the end of the academic preparation in June, 1987, all agreed or strongly agreed that they could do an effective job of "hands-on-science" teaching.

By the end of the 1987-88 school year, the 36 team members and 3 field supervisors had presented more than 117 major, in-service programs including presentations before area and state groups. Members of five teams have made out-of-state presentations to groups of teachers, and one team was invited to another state to explain its program for reform to that state's Board of Education.

Through their presentations at local, area, and state professional meetings, the ESEI teachers, principals, and supervisors have assumed a leadership function that has cast them as exemplars in their field. An estimated 60% have added at least one additional professional affiliation over the past year. The combined effect of the media attention and successful attainment of her team's goals prompted one team teacher to make this enthusiastic statement to the new teams at the opening of the 1988 Institute: "Just a year ago, I was very discouraged, but I feel very, very good about being a science teacher now; and that makes my whole life and all the years of school and all the work in my classroom seem more than worthwhile. What we do is important, and folks realize that!"

Conclusion

Doyle and Hartle (1985) contended that, for an effective educational program, classroom teachers must be active participants rather than passive followers in the quest for reform. The ESEI model was designed to provide the opportunity for central involvement. Each participating school system gained a unique team of educators cognizant of both the instructional and administrative dimensions of educational program development. This clearer understanding of both perspectives enabled the teachers and administrators to overcome many hurdles by pulling together for better science education, and seven of the nine 1987 teams evaluated themselves as having accomplished very substantial reforms within the 1987-88 school year.

Public awareness and support for elementary science education may be among the most important benefits produced by the ESEI model of local team leadership development. Several teams, for example, reported voluntary involvement of parents in such activities as the collection and packaging of materials for science lessons.

Participating school systems therefore found within their own ranks the grass-roots leadership and in-service training capabilities necessary to follow the new direction in elementary science education in Tennessee. The teams in the 1988 Institute appear to be achieving equally successful results, providing additional evidence that rural school systems can bring about reform within their own ranks through local leadership development.

References

Clement, J. (1982). Students' preconceptions in introductory mechanics. American Journal of Physics, 50(1), 66-71.

Doyle, P. D. & Hartle, T. W. (1985). Leadership in education: governors, legislators, and teachers. Kappan, 67(1), 21-27.

Driver, R. (1983). The pupil as scientist? Milton Keynes, England: The Open University Press.

Field, M. H. (1988). A chronicle of changes for elementary science in Tennessee. Education. 108(4), 419-426.

Gabel, D., Samuel, K., Helgeson, S., McGuire, S., Novak, J., and Butzow, J. (1987). Science education research interests of elementary teachers. Journal of Research in Science Teaching. 24(7), 659-677.

General Accounting Office. (1984). New directions for federal programs to aid mathematics and science teaching. Washington, D.C.: United States General Accounting Office.

Hurd, P. (1986). Perspectives for the reform of science education. Phi Delta Kappan, 85(6), 353-358.

McCloskey, M. (1983). Intuitive physics. Scientific American, 248(4), 122-130.

Mechling, K., & Oliver, D. (1982). Handbook II: The principal's role in elementary school science. Washington, D.C.: National Science Teachers Association.

Mechling, K., & Oliver, D. (1983). Handbook I: Science teachers' basic skills. Washington, D.C.: National Science Teachers Association.

National Commission on Excellence in Education. (1983). A nation at risk. Washington, D.C.: U. S. Department of Education.

National Science Foundation. (1978). The status of pre-college science, mathematics, and social studies educational practices in U.S. schools: An overview and summary of three studies. Washington, D.C.: U. S. Government Printing Office.

National Science Teachers Association. (1983). Recommended standards for the preparation and certification of teachers of science at the elementary and middle/junior high school levels. (An NSTA position statement). Science and Children. 21(1), 65-70.

Prather, P., Hartshorn, R., & McCreight, D. (1988). A team leadership development program: The Elementary Science Education Institute(ESEI). Education. 108(4), 454-461.

Rutherford, W. L. (1985). School principals as effective leaders. Kappan, 67(1), 31-34.

Stake, R., & Easley, J. (1978). Case studies in science education, Volumes I and II. Washington, D.C.: U.S. Government Printing Office.

Weiss, I. (1978). Report of the 1977 national survey of science, mathematics, and social studies education. Washington, D.C.: U.S. Government Printing Office.

Yager, R. (1981). An analysis of the secondary science curriculum for action in the 1980's (1982 AETS yearbook). Columbus, Ohio: Ohio State University. (ERIC document reproduction number SE-03-0-586).